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ABSTRACT

The fourth phase of a longitudinal study focusing on the cognitive and language development of children in a primary-grade Spanish immersion program (SIP) is reported. Subjects were the remaining 13 members of an SIP cohort beginning in 1987, 15 members of a standard program comparison classroom, 18 members of another class in the 1987 SIP cohort, 37 members of a second SIP cohort, and 17 members of a same-grade standard-program comparison group. Classroom observations were made in fall 1987 (first SIP cohort only) and in the spring of 1988, 1989, and 1990. The children were tested individually on three measures, including: a test of nonverbal problem-solving ability, an English vocabulary measure, and a Spanish vocabulary test. Results indicate that while the SIP children demonstrated significant gains in nonverbal problem-solving over comparison classrooms between the first and second observations in grade 2 and maintained their gains at grade 3, the difference had attenuated by grade 4. No significant differences in native language development were found at grade 4, despite instruction almost exclusively in Spanish for 2 and 3 years. It is concluded that a common underlying linguistic proficiency facilitates transfer of skills from the first to second language. A 39-item bibliography is included. (MSE)

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# Cognitive and Language Development in an Additive-Bilingual Program: Report after Four Observations

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# Cognitive and Language Development in an Additive-Bilingual Program: Report after Four Observations

The relationship between language study and general cognitive abilities has long fascinated philosophers and psychologists. In the nineteenth century, faculty psychologists asserted that exercising the mind on the forms of Latin would enhance a student's cognitive abilities in general (Lewis, 1905). Early in the twentieth century, convincing arguments by Thorndike and Woodworth (1901) and the concurrent rise of experimental psychology effectively discredited such claims of formal discipline. Since 1962, however, psychologists have been reexamining the relationship between language acquisition and cognitive development. Taken as a whole, a broad body of research indicates that in an additive-bilingual setting children may demonstrate gains in certain cognitive abilities over their monolingual peers (for a review, see Cummins, 1976). The necessarily quasi-experimental nature of all bilingual research and the importance of the question at a time of increasing enrollment of bilingual children in North American schools call for further study.

## *Nonverbal Problem-Solving*

Vygotsky noted the importance of metalinguistic reflection in the development of abstract, decontextualized thought (Vygotsky, 1986; Wertsch, 1985; Donaldson, 1978). Bilingual children have demonstrated superior metalinguistic ability over their monolingual peers (Ben-Zeev 1977; Bialystok, 1986a; Cummins, 1978a; Ianco-Worrall, 1972). Recently, Bialystok and Ryan (1985) pointed out that the current array of

metalinguistic tasks vary in their demand for analyzed knowledge and cognitive control, and subsequently Bialystok (1985b, 1988) demonstrated that bilingual children outperform their monolingual comparison groups on metalinguistic tasks requiring high levels of cognitive control.

The superior cognitive control demonstrated by bilingual children may be useful in nonverbal problem-solving. A within-group analysis of an additive Spanish-English bilingual education program revealed a significant relationship between nonverbal problem-solving and bilingual development among children in grades K and 1 (Hakuta & Diaz, 1985; Hakuta, 1987). In addition, longitudinal research demonstrated significant gains in nonverbal scores by a French-immersion K-1 class over their monolingual comparison group (Samuels and Griffore,1979).

Additional evidence of the positive cognitive benefits of additive-bilingualism was reported in the first year of the present study (Bamford & Mizokawa, 1989). Members of a grade 2 Spanish-immersion (SIP) classroom significantly outperformed their comparison group on a measure of nonverbal problem-solving between fall and spring observations. Subsequently, at grade 3 the SIP children maintained their significant gain in nonverbal ability between the first and third observations (Bamford & Mizokawa, 1990). In addition, within-group analyses of the SIP group revealed a significant relationship between bilingual development and nonverbal problem-solving at grade 2 for both Cohort 1 (Bamford & Mizokawa, 1989) and Cohort 2 (Bamford & Mizokawa, 1990) groups.

*Native-Language Development*

Chomsky (1972) asserted the existence of an underlying linguistic competence, independent in representation from any particular language. Cummins (1981) likewise argued for a unitary linguistic capacity, in terms of a common underlying linguistic proficiency that allows transfer of skills and knowledge between native language ($L_1$) and second language ($L_2$). In support of a unitary linguistic capacity, Hakuta (1987) reported an increasing correlation over time between $L_1$ and $L_2$ skills in a study of Spanish-English additive-bilingual children.

The developmental-interdependence hypothesis of Skutnabb-Kangas cited by Cummins (1978b) predicts that children acquiring linguistic proficiency in $L_x$ will transfer such proficiency to $L_y$, provided they receive support for $L_y$ from home or school and $L_y$ is positively valued. The concept of additive-bilingualism (Lambert, 1984) likewise predicts that children educated in $L_2$ will suffer no retardation in $L_1$ development given adequate support for $L_1$ and motivation to learn $L_2$.

Evaluations of French-immersion programs in Canada report either that there are no significant differences in $L_1$ development between immersion and comparison classrooms (Barik & Swain, 1976; Bruck, Lambert & Tucker, 1974; Gray, 1986; Lambert, Tucker & d'Anglejan, 1973; Swain, Lapkin & Andrew, 1981), or that no significant differences exist following the introduction of $L_1$ language arts instruction (Barik & Swain, 1975; Genesee, Holobow, Lambert, Cleghorn & Walling, 1985; Shapson & Day, 1982). Likewise, in the present study no significant differences in $L_1$

development were revealed between SIP and comparison classrooms over the course of the first two years (Bamford & Mizokawa, 1989; Bamford & Mizokawa, 1990).

This is the fourth report of a longitudinal study of the cognitive and language development of children enrolled in a primary-grade SIP in a suburban school district in Washington State (for earlier reports see Bamford, 1988; Bamford & Mizokawa, 1989; Bamford & Mizokawa, 1990). Members of the grade 4 SIP Cohort 1 group were compared to a standard-program comparison classroom from the same community over the course of three years on measures of nonverbal problem-solving and native-language development.

In addition, members of the SIP grade 3 Cohort 2 group were compared to a standard-program classroom over the course of two observations. It was hypothesized that the SIP groups would demonstrate significant gains in nonverbal problem-solving ability over their respective standard-program comparison groups. Second, no significant differences in $L_1$ development between SIP and standard-program classrooms were predicted. Third, among the SIP children it was expected that a significant relationship would exist between nonverbal problem-solving and degree of bilingualism attained. Finally, among the SIP children it was predicted that $L_1$ development would significantly predict development in $L_2$. Alpha = .05.

## Method

### *Subjects*

Subjects included the remaining 13 members (6 boys and 7 girls) of the Cohort 1 SIP intact classroom which began the study in the fall of 1987, and the remaining 15 members (9 boys and 6 girls) of the intact standard program comparison classroom. In the spring of 1988, a second Cohort 1 SIP classroom was brought into the study to facilitate SIP within-group analyses, of which 18 children (7 boys and 11 girls) remained in 1990. For dates of observation of immersion and comparison classrooms, see Table 1.

Table 1

*Dates of Observation of Immersion and Comparison Cohorts*

| | Grade 2 | | Grade 3 | Grade 4 |
|---|---|---|---|---|
| | Fall | Spring | Spring | Spring |
| Cohort 1 | 1987 | 1988 | 1989 | 1990 |
| Cohort 1b | | 1988 | 1989 | 1990 |
| Cohort 2 | | 1989 | 1990 | |

*Note*: The Cohort 1b children are a second immersion Cohort 1 classroom brought into the study to permit the within-groups comparisons.

In addition, 37 members (16 boys and 21 girls) of the SIP Cohort 2 grade 3 group and 17 members (11 boys and 6 girls) of a grade 3 standard-

program comparison classroom remained for a second comparison in 1990. The SIP and comparison classrooms were located in separate schools of comparable social and economic status in the same community. *T*-tests indicated no significant differences in gender or age between the respective SIP and comparison classrooms at the first observation. All children who desired to participate in the study were tested. Children with a hearing deficit, who had repeated a grade, or who were members of a comparison classroom and either bilingual or bussed into the school to attend a magnet gifted program were not included in the analyses.

***Instrumentation***

The *Standard Progressive Matrices* (SPM) (Raven, 1960) provided a measure of nonverbal problem-solving ability for the members of both the Cohort 1 (fourth grade) and Cohort 2 (third grade) groups.

The *Peabody Picture Vocabulary Test-R* (PPVT-R) (Dunn, Dunn, Robertson & Eisenburg, 1981) was selected as a measure of native-language development for both the Cohort 1 and Cohort 2 children..

The *Test de Vocabulario en Imágenes Peabody* (TVIP) (Dunn, Padilla, Lugo & Dunn, 1986), a test of receptive Spanish vocabulary, was administered to Cohort 1 and Cohort 2 members of the SIP at least one week following the administration of the PPVT-R.

All children were tested individually in a private room at school by the first author. Program was the independent variable in two comparisons for both the Cohort 1 andCohort 2 groups. In the first comparison, nonverbal problem-solving as measured by the SPM was the

dependent variable. In the second comparison, $L_1$ development as measured by the PPVT-R was the dependent variable.

In addition, two within-group analyses were made among the SIP children by cohort. In the first, bilingual development as measured by the TVIP was the predictor variable, and nonverbal problem-solving as measured by the SPM as the outcome measure. In the second within-group analysis, $L_1$ development as measured by the PPVT-R was the predictor variable with $L_2$ development as measured by the TVIP as outcome measure.

## Results

### *Nonverbal Problem-Solving*

*Between groups.* The 1990 nonverbal scores for the grade 4 Cohort 1 group were compared longitudinally to scores from prior observations in 1987, 1988, and 1989. For means and standard deviations, see Table 2. Although the CPM had been administered in grade 2, to avoid a ceiling effect the SPM was administered in grades 3 and 4. Because of the change in instruments, raw scores on the CPM and SPM were converted to $z$ - scores, and a MANCOVA applied, with PPVT-R scores, sex and age as covariates. No significant differences were revealed between the grade 4 Cohort 1 groups using Hotelling's $T^2$ criterion. See Figure 1.

Likewise, the same analysis was applied to the grade 2 and 3 nonverbal scores of the Cohort 2 group. For means and standard deviations, see Table 3. No significant differences were revealed. See Figure 2.

Table 2

*Means and Standard Deviations of Immersion and Comparison Cohort 1 Groups on Raven's Coloured and Standard Progressive Matrices*

| | | Immersion | Comparison |
|---|---|---|---|
| Grade 2, Fall | | | |
| | *n* | 19 | 19 |
| | *M* | 25.00 | 26.16 |
| | *SD* | 4.87 | 5.13 |
| Grade 2, Spring | | | |
| | *n* | 19 | 19 |
| | *M* | 28.90 | 27.42 |
| | *SD* | 4.58 | 4.71 |
| Grade 3 | | | |
| | *n* | 15 | 16 |
| | *M* | 38.47 | 36.44 |
| | *SD* | 6.94 | 5.21 |
| Grade 4 | | | |
| | *n* | 13 | 15 |
| | *M* | 41.77 | 41.13 |
| | *SD* | 4.21 | 4.87 |

*Note:* Some analyses are based only on cases for whom complete data were available.

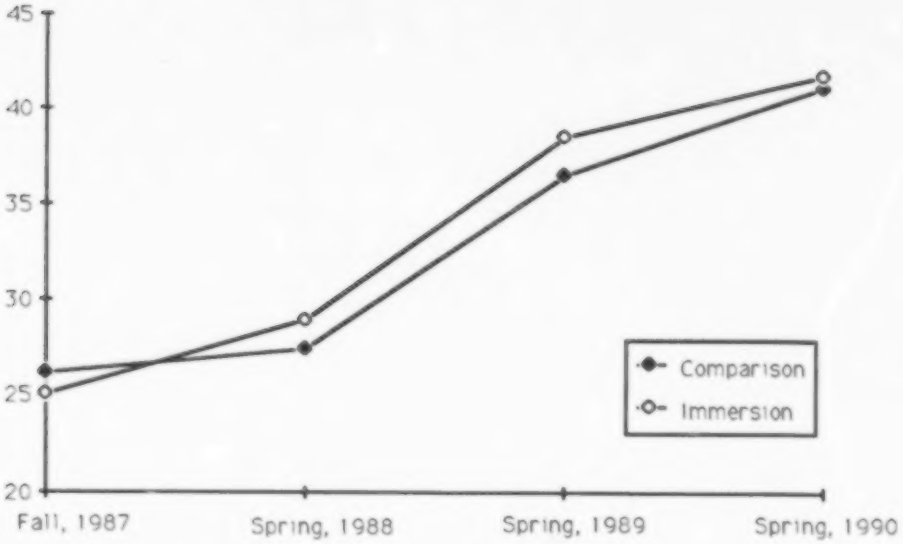


*Figure 1. Mean raw scores of the Cohort 1 immersion and comparison groups on Raven's Coloured Matrices and Raven's Progressive Matrices.*

*Within-groups.* Regression analyses revealed no significant relationship between nonverbal problem-solving as measured by the SPM and bilingual development as measured by the TVIP in neither the Cohort 1 classroom at grade 4 nor the Cohort 2 group at grade 3.

***Native-Language Development***

*Between-groups.* A MANCOVA was applied to grade 4 Cohort 1 group scores on the PPVT-R from 1987, 1988, 1989, and 1990, with nonverbal scores, gender and age as covariates. For means and standard deviations, see Table 4. No significant differences were revealed using Hotelling's $T^2$ criterion. See Figure 3.

Table 3

*Means and Standard Deviations of Immersion and Comparison Cohort 2 groups on Raven's Coloured and Standard Progressive Matrices*

| | | Immersion | Comparison |
|---|---|---|---|
| Grade 2 | | | |
| | *n* | 39 | 20 |
| | *M* | 25.20 | 25 |
| | *SD* | 4.68 | 4.18 |
| Grade 3 | | | |
| | *n* | 37 | 17 |
| | *M* | 34.19 | 33 |
| | *SD* | 8.01 | 8.04 |

*Note:* Some analyses are based only on cases for whom complete data were available.

*Within-groups.* A regression analysis applied to outcomes of the PPVT-R and the TVIP revealed a significant relationship between native language and second language development among members of the SIP grade 4 Cohort 1 group, multiple $R = .46$, $p = .009$. Likewise, the same test applied to the SIP grade 3 Cohort 2 group scores revealed a significant relationship between $L_1$ and $L_2$ development as measured by the PPVT-R and the TVIP, multiple $R = .388$, $p = .019$.

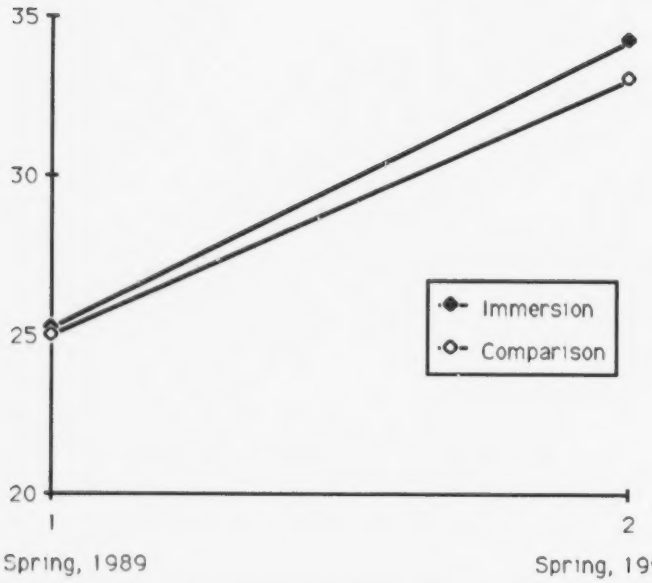


*Figure 2. Mean scores of the Cohort 2 classrooms on Raven's Coloured Matrices and Raven's Standard Progressive Matrices.*

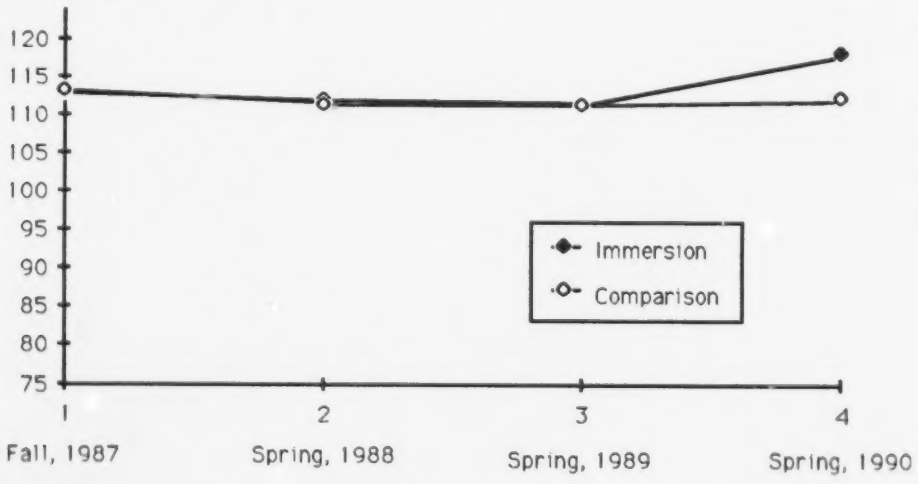


*Figure 3. Mean standard scores of the Cohort 1 immersion and comparison groups on the Peabody Picture Vocabulary Test-Revised.*

Table 4

*Means and Standard Deviations of Immersion and Comparison Cohort 1 Groups on Peabody Picture Vocabulary Test-Revised*

| | | Immersion | Comparison |
|---|---|---|---|
| Grade 2, Fall | | | |
| | *n* | 19 | 19 |
| | *M* | 112.90 | 113.05 |
| | *SD* | 15.50 | 9.86 |
| Grade 2, Spring | | | |
| | *n* | 19 | 19 |
| | *M* | 111.74 | 111.26 |
| | *SD* | 17.93 | 11.82 |
| Grade 3 | | | |
| | *n* | 15 | 16 |
| | *M* | 111.33 | 111.25 |
| | *SD* | 20.12 | 10.90 |
| Grade 4 | | | |
| | *n* | 13 | 15 |
| | *M* | 118.08 | 112 |
| | *SD* | 17.63 | 13.37 |

*Note:* Some analyses are based only on cases for whom complete data were available.

Again, the same test was applied to the grade 2 and 3 scores of the Cohort 2 group on the PPVT-R. For means and standard deviations, see Table 5. Again, no significant differences were revealed. See Figure 4.

Table 5

*Means and Standard Deviations of Immersion and Comparison Cohort 2 Groups on Peabody Picture Vocabulary Test-Revised*

| | | Immersion | Comparison |
|---|---|---|---|
| Grade 2 | | | |
| | *n* | 38 | 20 |
| | *M* | 104.92 | 108.85 |
| | *SD* | 10.78 | 13.96 |
| Grade 3 | | | |
| | *n* | 36 | 17 |
| | *M* | 105.81 | 109.77 |
| | *SD* | 11.21 | 15.49 |

*Note:* Some analyses are based only on cases for whom complete data were available.

***Within groups.*** As predicted, and in replication of results of prior observations, a regression analysis applied to outcomes of the Cohort 1 PPVT-R and the TVIP revealed a significant relationship, $r = .46, p = .009$. Likewise, among the Cohort 2 children, grade 3 scores revealed a

significant relationship between PPVT-R and TVIP scores, $r = .388$, $p = .019$.

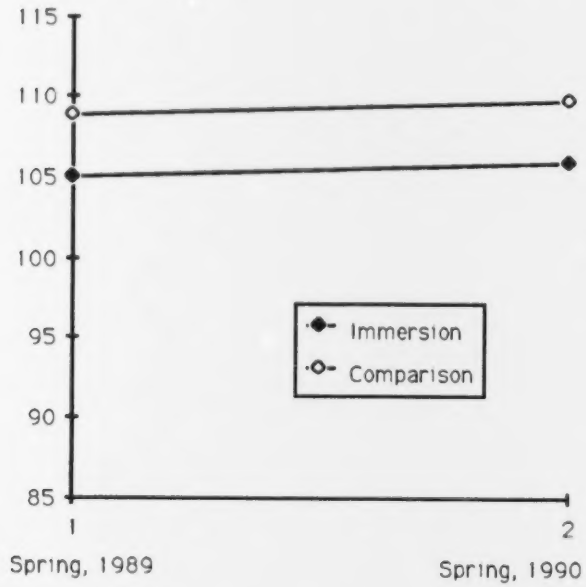


*Figure 4. Mean standard scores of the Cohort 2 immersion and comparison groups on the Peabody Picture Vocabulary Test-Revised.*

For a summary of the hypotheses and results of the study over the entire length of the project, please see Table 6.

Table 6

*Summary of Results over Four Observations, Including Results Reported in Bamford & Mizokawa (1989, 1990)*

| | Grade 2 | Grade 2 | Grade 3 | Grade 4 |
|---|---|---|---|---|
| Hypothesis | Fall | Spring | Spring | Spring |
| Bilingualism promotes nonverbal ability | | | | |
| Cohort 1 | | yes* | yes* | no |
| Cohort 2 | | | no | |
| Bilingualism predicts nonverbal ability | | | | |
| Cohort 1 | | yes** | no | no |
| Cohort 2 | | yes** | no | |
| No difference in $L_1$ development | | | | |
| Cohort 1 | | yes | yes | yes |
| Cohort 2 | | yes | yes | |
| $L_1$ predicts $L_2$ | | | | |
| Cohort 1 | | yes** | yes* | yes** |
| Cohort 2 | | yes* | yes* | |

*Note.* $^*p < .05$, $^{**}p < .01$

## Discussion

While the SIP children had demonstrated significant gains in nonverbal problem-solving over their comparison classroom between the first and second observations at grade 2, and had maintained their gains at grade 3, this report indicates that the difference in nonverbal skills between the two groups had attenuated by grade 4. In terms of the relationship between nonverbal problem-solving and degree of bilingualism, a significant effect was reported in the Cohort 1 group at grade 2, but not at grade 3 nor here at 4. Likewise, among the Cohort 2 children, a significant relationship between nonverbal problem-solving and degree of bilingualism was demonstrated at grade 2, but not in this report at grade 3.

Thus, the strongest evidence that additive-bilingualism may contribute to cognitive development in terms of nonverbal problem-solving was found at grade 2 in both the Cohort 1 and Cohort 2 classrooms.

At grade 3, only the maintenance of significant initial gains by the Cohort 1 group remained, and finally, at the present grade 4 observation, no significant effects were revealed. These findings support Hakuta's (1987) within-group analyses of an additive Spanish-English bilingual education program, where significant links between bilingualism and nonverbal cognitive measures were found in kindergarten and first grade groups, but weakened among the older children. Similarly, the pattern of

evidence revealed by this longitudinal study supports Diaz' (1985) challenge to Cummins' (1976) threshold hypothesis, in that the degree of bilingualism may be related to cognitive measures "only *before* a certain level of second-language proficiency has been achieved" (p. 1386). English language arts instruction was introduced to the SIP children during grade 2. Thus, the interaction of biliteracy, bilingualism, and school entry, three factors thought to promote cognitive control, may have provided the SIP children with an acceleration of symbolic reasoning abilities during the primary years, while the standard-program children may have been slower to develop the metalinguistic insight that promotes abstract thought.

In terms of native language ability, results of this study at grade 4 have once again failed to reveal any significant differences in development between the Cohort 1 SIP children and their corresponding comparison classroom. This report adds, as well, the longitudinal comparison of the Cohort 2 group between grades 2 and 3, with a corresponding lack of significant effects. Thus, over the course of grades 2, 3, and 4, the SIP children have been educated almost entirely in Spanish, with no retardation of their English language development, at least as measured by a test of receptive English vocabulary. The children's acquisition of English school-related language may be supported by transfer between $L_1$ and $L_2$, as suggested by Lambert (1972). Certainly, the support given to English development from family discussions, books and newspapers in

the home, and attendance at community cultural events is important among these middle-class children.

A consistent finding of this study is the statistically reliable relationship between $L_1$ and $L_2$ abilities, which was reported for the Cohort 1 group at grades 2 and 3, and now at grade 4, and among the Cohort 2 children at grade 2 and now at grade 3. These outcomes lend support for Cummins' (1981) notion of a common underlying linguistic proficiency which facilitates transfer of skills and knowledge between $L_1$ and $L_2$. Likewise, this pattern of results is to be expected if, as in Chomsky's (1978) view, $L_1$ and $L_2$ are merely surface manifestations of an underlying linguistic competence.

Two cautions must be noted. First, as McNab (1979) pointed out, immersion children are self-selected, and thus their development may differ from children in the standard-program on that basis alone. Second, children become bilingual for a variety of reasons, reasons that are crucial to the understanding of their bilinguality. Members of the SIP in this study are subject to a variety of social-psychological forces, and generalization of the results of this investigation should be limited to groups of children subject to similar dynamics.

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